AD-A132 441 OPERATING AND SUPPORT COST ESTIMATING GUIDE SAMPLE ANALYSIS AIR FORCE AIRCRAFT AT DSARC III(U) COST ANALYSIS IMPROVEMENT GROUP WASHINGTON D C 01 JAN 80 1/1

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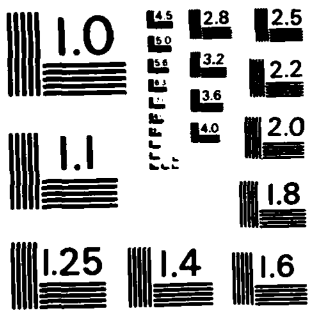

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* * *

OPERATING

and

SUPPORT

COST ESTIMATING GUIDE

SAMPLE ANALYSIS
AIR FORCE AIRCRAFT AT DSARC III

* * *

Office of the Secretary of Defense
Cost Analysis Improvement Group

1 January 1980

FORWARD

DOD Directive 5000.4 "OSD Cost Analysis Improvement Group", provided the charter for the Cost Analysis Improvement Group (CAIG) to review and establish criteria, standards, and procedures concerning the preparation and presentation of cost estimates on defense systems to the DSARC and CAIG. In support of this objective, the CAIG has periodically issued guidance for development and presentation of Operating and Support (O&S) cost for OSD review. To date general guidance has been made available for aircraft, ships, and ground combat vehicles.

In consonance with that general guidance, the following sample of a CAIG Operating and Support Cost Estimate Report covering a hypothetical case has been developed to further assist the cost analyst in the preparation of cost estimating reports submitted to the DSARC and CAIG during the acquisition process of a new weapon system.

This sample is not intended to imply the existence of a specific acquisition program. Nor does it imply a preference for one analysis technique over another. The sample is intended to show an example of how Operating and Support Costs can be developed for CAIG review with available data bases and one example of an appropriate format for presentation of cost estimates.

Existing data bases were used only to illustrate the need to relate an estimate to an existing similar system and to ensure a constant relationship between values and the Cost Element Structure. It is not used to promulgate the use of specific data bases. Each case should address that data which is the most complete and accurate for its purposes. Further, the level of detail depicted in this example may be greater or less than that which is available or appropriate to a specific case.

The sample is designed to complement the Cost Analysis Improvement Group's Aircraft Cost Development Guide. Jointly, these two documents can provide the basis for program manager developing a cost estimate that is acceptable for CAIG review.

EXECUTIVE SUMMARY

Operating and Support (O&S) costs for the FX and the current F-4E system (baseline) are shown below. These figures are compared to the figures presented to the DSARC at Milestone IIB.

DSARC IIB to DSARC III Comparison
FY 80 $ - Millions, 24PAA/Sqdn

	DSARC IIB (31FH/PAA/MO) ($0.50/gal POL)		Current Estimate (24FH/PAA/MO) ($1.50/gal POL)	
	F-4E	FX	F-4E	FX
$/Acft/yr	$1.5	$.9	$1.6	$1.1
$/Sqdn/yr	$ 34.9	$22.0	$38.8	$25.9
15 yr Force O&S	$24,185.7	$15,246.0	$26,888.4	$17,925.3

The force O&S costs are based on a five year delivery schedule plus ten years of full force operations of 912 PAA . . . .

The costs growth reflected in both the F-4E, baseline and the FX system is due mainly to the unprecedented rise in POL costs. This is in spite of a seven hour per PAA reduction in the projected flying hour program. The current estimate of the FX costs also includes costs covering an increase of 19 maintenance technicians . . . .

Although the FX represents a dramatic increase in performance, O&S costs will decrease by 33%. This is due to . . . .

GUIDANCE: THE EXECUTIVE SUMMARY IS A SAMPLE ONE PAGE NARRATIVE PROVIDING THE BOTTON LINE COSTS, FORCE SIZE AND MAJOR COSTS DRIVERS, AND ASSUMPTIONS. INCLUDE A BRIEF EXPLANATION OF DIFFERENCES PREDICTED FROM THE BASELINE SYSTEM AND THE DSARC MILESTONE IIB COST ESTIMATIONS.

CONTENTS

CONTENTS

1. INTRODUCTION

The following cost analysis report is submitted in support of Defense Systems Acquisition Review Council (DSARC) Milestone III review of the FX Program . . . . All values included in this report are in FY 80 dollars unless indicated otherwise.

GUIDANCE: IDENTIFY THE MILESTONE MISSION ELEMENT NEEDS STATEMENT (MENS) AND DECISION COORDINATING PAPER (DCP) WITH DATE AND THE BASE YEAR FOR COSTS IN THE INTRODUCTION.

The FX is intended to replace the F-4 in the Tactical Air Force. Although the F-4 is a proven aircraft, it uses 1950s technology in instrumentation, weapons delivery, and power plants . . . .

GUIDANCE: INCLUDE A SHORT STATEMENT SUMMARIZING THE MENS/DCP AND ANY SIGNIFICANT DEVIATIONS THAT THE COST ANALYSIS MAKES FROM THE DOCUMENTS.

The purpose of this program is to provide an air combat fighter capable of achieving and maintaining combat theater air superiority as well as providing close air support to ground operations. The FX is intended to . . . .

. . . . Based on a prototype fly-off, the X/Z Corporation was awarded a Full Scale Development (FSD) contract to produce 8 FSD aircraft. The FX met all performance specifications and achieved the lowest operating and support (O&S) cost. The FX is a state-of-the-art aircraft with Heads Up Display (HUD) instrumentation, fly-by-wire flight controls, composite flight control surfaces . . . . In the process of evaluating the risk associated with state-of-the-art technology and to assist in subsystem selection, the FSD aircraft have flown ____ hrs . . . . A photograph of the FX is presented in Figure 1. . . .

O&S costs are computed based on the following force levels:

TAC - 5 wings, 15 squadrons, 360 PAA
AFE, PACAF&AAC - 5 wings, 15 squadrons, 360 PAA
*AFRES & ANG - 16 groups/squadrons, (12UE), 192 PAA
Combat Crew Trng - 6 squadrons (34UE), 204 PAA

*Not costed in this report.

The flying hour program is 290 hrs/PAA/year for operational aircraft and 265 hrs/PAA/year for Combat Crew Training aircraft . . . .

GUIDANCE: ALSO, OUTLINE THE PROGRAM, ITS STAGE OF DEVELOPMENT, MAJOR SYSTEM PARAMETERS, AND MAJOR POTENTIAL RISKS THAT IMPACT OPERATING AND SUPPORT (O&S) COSTS.

Table 1 presents O&S costs for the baseline aircraft (F-4E) and the FSD FX aircraft. The data is shown for a squadron of 24 aircraft operating for one year. The F-4E was chosen as the baseline aircraft because, although the FX is intended to eventually replace most, if not all, F-4 aircraft, the F-4E most closely matches the mission mixes currently planned for the FX and flown by the FSD aircraft.

In Table 2, the cost estimates at DSARC IIB are presented with the current estimate. Reasons for significant variances from DSARC IIB are also given.

Table 3 presents the O&S costs for the life cycle of the FX with the procurement delivery schedule as listed in the Weapon System Planning Document (WSPD) for FX dated . . . .

These costs are based on a squadron of mature aircraft. To account for non-operating time due to aircraft delivery schedules, all aircraft delivered within a given year are assumed to accrue costs for only half of the year of delivery.

GUIDANCE: THE TABLE LISTING THE O&S ANNUAL COSTS FOR A TYPICAL DEPLOYABLE UNIT SHOULD REFLECT THE COST ELEMENT STRUCTURE (CES) ARRIVED AT THROUGH CONSULTATION WITH THE COST ANALYSIS IMPROVEMENT GROUP (CAIG). THE COSTS SHOULD ALSO BE COMPARED TO THOSE PRESENTED TO THE DSARC AT MILESTONE II AND THE COSTS DIFFERENTIALS EXPLAINED. THE O&S COSTS SHOULD ALSO BE PRESENTED BY FISCAL YEAR. THESE FIGURES SHOULD BE IDENTICAL TO THE FIGURES PRESENTED IN THE INTEGRATED PROGRAM SUMMARY (IPS).

Figure 1. FX Aircraft

TABLE 1. ANNUAL OPERATING AND SUPPORT COSTS
(THOUSANDS, FY80$)

1 SQUADRON, 24 PAA, 290FH/PAA/YR

	F-4E		FX	
Unit Mission Personnel		$ 7,862		$ 6,923
Aircrew	$ 845		$ 845	
Maintenance	5,459		4,520	
Other	1,558		1,558	
Unit Level Consumption		21,188		10,691
POL	17,351		7,339	
Maintenance Material	1,587		2,190	
Training Ordnance	2,250		1,162	
Depot Level Maintenance		5,407		4,083
Airframe Rework	2,145		1,126	
Engine Rework	1,208		723	
Component Repair	2,054		2,099	
Support Equipment	NOT AVAILABLE			
Software	-		135	
Modifications	SEE MODIFICATION KITS			
Other Depot	-		-	
Contract Unit Level Spt	-		-	
Sustaining Investment		1,026		1,211
Replenishment Spares	754		770	
Replacement Spt Equip	201		317	
Modification Kits	71		124	
Other Recurring Inv.	-		-	
Installation Spt Pers		466		401
Base Operating Support	386		332	
Real Property Management	45		39	
Medical	35		30	
Indirect Personnel Support		235		208
Misc Operations & Maint	-		-	
Medical O&M (Non-Pay)	-		-	
PCS	235		208	
Depot Non-Maintenance		529		399
General Depot Support	529		399	
Second Dest Trans	NOT AVAILABLE			
Pers Acquisition & Training		2,066		1,950
Acquisition	811		773	
Individual Training	1,255		1,177	
TOTAL		$38,779		$25,866

TABLE 2. DSARC IIB TO DSARC III COMPARISON
ANNUAL OPERATING AND SUPPORT COSTS
(THOUSANDS FY80$)

1 SQUADRON, 24 PAA

	Current	Est	DSARC IIB	Est	Change	Comment
Unit Mission Personnel		$ 6923		$6211		
Aircrew	$ 845		$ 782		+ 63	8
Maintenance	4520		3988		+ 532	1,8
Other	1558		1441		+ 117	8
Unit Level Consumption		10,691		8491		
POL	7339		5161		+2178	2,7
Maintenance Material	2190		2168		+ 22	
Training Ordnance	1162		1162			
Depot Level Maintenance		4083		3809		
Airframe Rework	1126		1075		+ 51	8
Engine Rework	723		710		+ 13	8
Component Repair	2099		1889		+ 210	8,9
Support Equipment	NOT AVAILABLE					
Software	135					
Modifications	SEE MODIFICATION KITS					
Other Depot	-					
Contract Unit Level Spt	-					
Sustaining Investment		1211		1157		
Replenishment Spares	770		716		+ 54	8
Replacement Spt Equip	317		317			
Modification Kits	124		124			
Other Recurring Inv	-					
Installation Spt Pers		401		378		
Base Operating Support	332		309		+ 23	6,8
Real Property Management	39		39			
Medical	30		30			
Indirect Personnel Support		208		192		
Misc. Operations & Maint	-					
Medical O&M (Non-Pay)	-					
PCS	208		192		+ 16	6,8
Depot Non-Maintenance		399		399		
General Depot Spt	399		399			
Second Dest Trans	NOT AVAILABLE					
Pers Acquisition & Training		1950		1804		
Acquisition	773		715		+ 58	6,8
Individual Training	1177		1089		+ 88	6,8
TOTAL		$25,866		$22,042		

Notes on Table 2:

1. Increase is due to the increase of 19 maintenance technicians over the original estimate.

2. Increase is due to the increase in Petroleum, Oils, and Lubricants (POL) costs from \$1.32/gal to \$1.50/gal in constant FY80 dollars.

3. . . . .

6. Increases are due to larger squadron manpower being supported.

7. Flying hour program reduced from <u>31</u> to <u>24</u>. The fuel consumption rate has increased from 645 gal/hr to 703 gal/hr based on actual flight test data on TACs peacetime flying scenario mix . . . .

8. Increase due to updated data base (FY79 vice FY78).

9. Increase due to miscalculation in previous report.

TABLE 3. TYPICAL FX FORCE OPERATING AND SUPPORT COSTS (MILLIONS, FY80$) FISCAL YEAR BREAKOUT 1402 AIRCRAFT

ANNUAL O&S COST

	FISCAL YEAR								
	82	83	84	85	86	87	1988-2001	02	TOTAL
Number of Operating Squadrons	5 2.5	12 8.5	22 17	32 22	38 35	38 36	38 532	38 38	-
Deliveries**	120	180	240	240	240	240	142		1402
Unit Mission Personnel	17.3	58.8	117.7	152.3	242.3	263.1	3,683.0	263.1	4,797.6
Installation Support Personnel	1.0	3.4	6.8	8.8	14.0	15.2	213.3	15.2	277.7
*Subtotal (MILPERS)	$18.3	$62.2	$124.5	$161.1	$256.3	$278.3	$3,896.3	$278.3	$5,075.3
Unit Level Consumption	26.7	90.9	181.7	235.2	374.2	406.3	5,687.6	406.3	7,408.9
Depot Level Maintenance	10.2	34.7	69.4	89.8	142.9	155.2	2,172.2	155.2	2,829.6
Indirect Personnel Support	.5	1.8	3.5	4.6	7.3	7.9	110.6	7.9	144.1
Depot Non-Maintenance	1.0	3.4	6.8	8.8	14.0	15.2	212.3	15.2	276.7
Personnel Acquisition & Training	4.9	16.6	33.2	42.9	68.3	74.1	1,037.4	74.1	1,351.5
*Subtotal (O&M)	$43.3	$147.4	$294.6	$381.3	$606.7	$658.7	$9,220.1	$658.7	$12,010.8
Sustaining Investment	3.0	10.3	20.6	26.6	42.4	46.0	644.3	46.0	839.2
*Subtotal (PROCUREMENT)	$3.0	$10.3	$20.6	$26.6	$42.4	$46.0	$644.3	$46.0	$839.2
*GRAND TOTAL	$64.6	$219.9	$439.7	$569.0	$905.4	$983.0	$13,760.7	$983.0	$17,925.3

** Delivery schedule is based on WSPD on FX dated ______________.

GUIDANCE: *NOTE: FIGURES ARE ALSO INCLUDED IN ANNEX B OF THE INTEGRATED PROGRAM SUMMARY.

2. ASSUMPTIONS AND GROUND RULES

2.1 General.

The FX avionics maintenance concept departs from that of previous fighter avionics maintenance concepts. The intermediate avionics maintenance will consist of circuit board remove and replace. Circuit board repair will be done at the Depot circuit board repair facility . . . . This concept results in a reduction in initial spares levels . . . . The interface test adapters (ITA) and the automatic test equipment (ATE) originally programmed have been reduced from 86 to 44 and 60 to 40 respectively to accommodate . . . .

GUIDANCE: INCLUDE A GENERAL DESCRIPTION OF SYSTEM CHANGES AND DISCUSS THEIR ANTICIPATED IMPACTS ON O&S COSTS INDICATING THE DEGREE OF CONFIDENCE THAT THE CHANGES ARE PRACTICAL AND COST IMPACTS ARE ACCURATE.

2.2 Baseline System.

As in the DSARC II report, the F-4E weapon system is used as the reference system. However, the data base was updated to include the latest year's data. The mission profile of the F-4E most closely resemble that of the FX . . . .

GUIDANCE: IDENTIFY THE BASELINE SYSTEM AND EXPLAIN THE RATIONALE USED IN ITS SELECTION. IF THE BASELINE SYSTEM WAS CHANGED FROM DSARC II EXPLAIN FULLY WHY THE CHANGE WAS NECESSARY.

2.3 System and Program Characteristics.

Table 4 illustrates aircraft and program characteristics of the alternatives . . . .

GUIDANCE: INCLUDE DETAILS OF THE ALTERNATIVE SYSTEM.

TABLE 4. OPERATIONAL TECHNICAL CHARACTERISTICS

Characteristic	Current Estimate
Size (length/wing span) (ft)	49.5/32.8
Design mission configuration (external fuel tanks as required)	
air-to-air mission (nbr AIM 9 missiles/rounds of 20 mm ammo)	2/500
air-to-ground mission (nbr/wt of weapon added and one ALQ-119 ECM ext POD added)	WPN: 2/2000 POD: 1/580
max speed (sea level)	classified
max speed (at altitude)	classified
design mission combat radius	classified
thrust to weight ratio take-off	classified
sustained turn ratio	classified
level acceleration	classified
max fully controllable load factor	classified
radar detection range	classified
ferry range (NM)	2152
take-off distance, 50 ft obstacle (ft)	2152
landing distance, 50 ft obstacle (all ord expanded) (ft)	3250
max take-off gross wt (lbs)	33,000
mission reliability (%)	86
MTBF (hrs) (See Table 9)	1.77

SCHEDULE MILESTONES

complete competition flt test	Dec 76
award dev contract	Jan 77
FSD (DSARC II)	Apr 77
radar contractor selection complete	Nov 77
1st FSD flt	Dec 78
LLP approval (IIIA)	Jan 79
Full Prod approv (IIIB)	Sep 79
First flt, prod Acft	Aug 80
First delivery	Sep 80
Delivery 100th prod acft	May 82

Extracted from the Selected Acquisition Report (SAR) as of ________.
Note: Classified data may be obtained from . . . .

2.4 Assumptions, Model Inputs, and Rates.

2.4.1 Design Sensitive Values. Table 5 lists the elements that are design-related . . . .

TABLE 5. DESIGN SENSITIVE VALUES

Elements	Value	Source	Opr	Ext
1. Unit Production Costs	$10.6M	Contractor Estimate	Jim Smith	75124
2. Portion of Flyaway Costs for Material	53%	Contractor Estimate	Jim Smith	75124
3. AMPR Weight	16,400 lbs	PM Projection	John Doe	73124
4. Avionics Weight	2,890 lbs	PM Projection	John Doe	73124
5. Fuel Consumption	703 gal/hr	AFTEC Test Data	John Doe	73124
6. Mean Flight Hours Between Failures	1.77 hours	See Table 9	John Doe	73124
7. Mean Flight Hours Between Unscheduled Maint. (MFHBUMA)	. . .	. . .	. . .	. . .
8. PDM	$350K/acft	. . .	. . .	. . .

2.4.1.1 Unit Production Costs.

The prototype manufacturing costs was compared with the prototype manufacturing costs of recent aircraft acquisitions and FX unit production costs projected based on other unit production costs . . . .

2.4.1.2 Portion of Flyaway Costs for Material . . . .

2.4.1.8 . . . .

GUIDANCE: DIVIDE VALUES USED IN THE COST ESTIMATING MODEL OR ALGORITHMS INTO TABLES DEPENDING ON THE NATURE OF THE PARAMETER INVOLVED.
TABLE 5 CONTAINS ELEMENTS WHICH ARE INHERENT TO THE SYSTEM DESIGN AND ARE DEPENDENT ON HARDWARE CONFIGURATION. FOLLOWING THIS TABLE IS A BRIEF EXPLANATION OF THE DERIVATION OF THE VALUE SELECTED FOR THE PARAMETER.

2.4.2 System Operational Standards.

Table 6 identifies the values used in this analysis which reflect current Air Force policy . . . .

TABLE 6. SYSTEM OPERATIONAL STANDARDS

Element	Value	Source	Opr	Ext
1. Average Utilization Rate	24 hr/mo	PM Projection	John Doe	73124
2. Acft per Sqdn	24 acft ops	PM Projection	John Doe	73124
3. Attrition Rate	.87%/acft/yr	PM Projection	John Doaks	77111
4. Pipeline Rate	10% ops acft	PM Projection	Joe Doe	77111
5. PDM Interval	89.5 mo	AF/LEM	Jack Smith	78192
6. . . .	. . .	. . .	. . .	. . .
7. Crew Ratio	1.25	PM Projection	John Doe	73124

2.4.2.1 Utilization Rate.

The FX will require about the same flying hours as the F-4E to support the training . . . . The use of flight simulation will . . . .

2.4.2.2 Aircraft per Squadron

The Wing Composition is based on current Air Force standards for a Tactical Fighter Squadron . . . .

2.4.2.3 Attrition Rate. . . . .

2.4.2.7 Crew Ratio.

The FX will be an all weather day/night aircraft. In order to support this multi-role weapon system, it will require a crew ratio of . . . .

GUIDANCE: LIST THOSE FACTORS ESTABLISHED BY THE USING COMMAND WHICH IMPACT O&S COSTS IN A TABLE. A BRIEF EXPLANATION AND DERIVATION OF THE VALUE SHOWN FOLLOWS THE TABLE.

2.4.3 Standard Values and Rates.

Table 7 lists the standard values and rates used and the source . . . .

TABLE 7. STANDARD VALUES AND RATES

Element	Value	Source	Opr	Ext
1. POL Costs	$1.50/gal	. . . .	Mary Doe	51234
2. Officer Standard Composite Rate	$27,000	ASD (COMP) Memo	-	-
3. Enlisted Standard Composite Rate	$11,500	ASD (COMP) Memo	-	-
4. Acft Service Life	15 years	ASD (COMP)	-	-
5. Escalation Factors	variable	ASD (COMP)	-	-
6. Base Year Dollars	FY 80	CAIG	Tom Mix	75631

GUIDANCE: HIGHLIGHT THOSE STANDARD VALUES WHICH ARE ESTABLISHED AND GENERALLY ACCEPTED IN A TABLE. THESE VALUES ARE NOT SUBJECT TO INFLUENCE BY THE SYSTEM UNDER CONSIDERATION OR THE USING COMMAND.

3. METHODOLOGY

3.1 General.

For this analysis the . . . O&S Cost estimating model was used. A summary of this model is provided in Appendix E . . . .

GUIDANCE: IF A GENERALLY APPLICABLE COMPUTERIZED COST ESTIMATING MODEL IS USED FOR THE ANALYSIS INSTEAD OF THE SERIES OF ALGORITHMS LISTED IN APPENDIX D OF THIS REPORT, INCLUDE SUMMARY OF THE MODEL USED, AS WELL AS APPROPRIATE COMPUTER PRODUCTS, IN APPENDIX E OF THE REPORT AND OMIT APPENDIX D.

3.2 Data Sources.

The sources used in defining the baseline costs and the method used in estimating the proposed system's cost are listed in Table 8 for each of the cost elements . . . .

GUIDANCE: INCLUDE A MATRIX OF SOURCES AND METHODS IN THE REPORT.

3.3 Derivation of Scalars.

In applying the baseline data to the FX and projecting costs it was necessary to establish a proportional relationship between the two systems. These proportions are explained in the following paragraphs . . . .

GUIDANCE: ESTABLISH SOME PROPORTIONAL RELATIONSHIP BETWEEN THE BASELINE SYSTEM AND THE ALTERNATIVES WHEN COST ANALYSIS DATA IS NOT DIRECTLY AVAILABLE FROM THE WEAPON SYSTEM UNDER CONSIDERATION. THIS RELATIONSHIP IS THEN USED TO SCALE THE BASELINE COSTS TO DETERMINE THE ESTIMATED COSTS OF THE ALTERNATIVE SYSTEMS.

3.3.1 Reliability and Maintainability.

For purposes of this costing analysis, Reliability and Maintainability (R&M) data is provided to the two digit Work Unit Code (WUC) levels in Table 9 . . . .

TABLE 8. DATA SOURCES AND METHODOLOGY

	F-4E BASELINE		FX AIRCRAFT	
Cost Element	Source	Method Existing Data:	Source	Method
UNIT MISSION PERS	ASD (COMP) Memo Jan 30, 1979	Normalized to a Sq/Yr	See Appendix A	Normalized to a Sqdn/Yr
UNIT LEVEL CONSUMPTION				
POL	AFP 173-13, 31 May 1979, Table 8	Normalized to a Cost/FH	See paragraph 3.5	Normalized to a Cost/FH
Maint Material	AFP 173-13, 31 May 1979, Table 1	Normalized to a Sq/Yr	Baseline	Scaled by Reliability & Material
Trng Ordnance	AFP 173-13, 31 May 1979, Table 7	Built-up from Crew Size	AFP 173-13, 31 May 1979, Table 7	Built-up from Crew Size
DEPOT LEVEL MAINTENANCE				
Airframe Rework	Selected Depot Reports	Normalized to a Cost/Acft	Contractor Estimate	Normalized to a Cost/Acft
Engine Rework	Selected Depot Reports	Normalized to a Sq/Yr	See Appendix C	Normalized to a Sqdn/Yr
Component Repair	Selected Depot Reports	Normalized to a Subsystem Cost/FH	See Appendix B	Built-up from a L/S analysis
Support Equipment	Included in Component Repair		Included in Component Repair	
Software	Not Applicable		Contractor Estimate	Based on Acft Procurement
Modifications	See Modification Kits		See Modification Kits	
Other Depot	Not Applicable		Not Applicable	
Contract Unit Lvl Spt	Not Applicable		Not Applicable	
SUSTAINING INVESTMENT				
Replenishment Spares	Selected Depot Reports	Normalized to a Subsystem Cost/FH	See Appendix B	Built-up from L/S analysis
Replacement Spt Equip	AFP 173-13, 31 May 1979, Table 14	Normalized to a Sq/Yr	Baseline	Scaled by Flyaway cost
Modification Kits	AFP 173-13, 31 May 1979, Table 39	Normalized to a Sq/Yr	AFP-173-13, 31 May 1979, Table 39	Normalized to a Sqdn/Yr
Other Recurring Inv	Not Applicable		Not Applicable	
INSTALLATION SPT PERS				
Base Operating Spt	AFP 173-13, 31 May 1979, Table 18,27&30	Normalized to a Sq/Yr	Baseline	Scaled by Sqdn manning
Real Prop Mgmt	AFP 173-13, 31 May 1979, Table 18,27&30	Normalized to a Sq/Yr	Baseline	Scaled by Sqdn manning
Medical	AFP 173-13, 31 May 1979, Table 27 & 30	Normalized to a Sq/Yr	Baseline	Scaled by Sqdn manning
INDIRECT PERS SPT				
Misc Operations & Maint	Not Available		Not Available	
Medical O&M (Non-Pay)	Not Available		Not Available	
PCS	AFP 173-13, 31 May 1979, Table 29	Normalized to a Sq/Yr	AFP 173-13, 31 May 1979, Table 29	Normalized to a Sqdn/Yr
DEPOT NON-MAINT				
General Depot Spt	AFP 173-13, 31 May 1979, Table 4	Normalized to a Sq/Yr	Baseline	Scaled by Depot Maint. Costs
Second Dest Trans	Not Available			
PERS ACQUISITION & TRNG				
Acquisition	AFP 173-13, 31 May 1979, Table 20	Normalized to a Sq/Yr	AFP 173-13, 31 May 1979, Table 20	Normalized to a Sqdn/Yr
Individual Training	AFP 173-13, 31 May 1979, Table 41	Normalized to a Sq/Yr	AFP 173-13, 31 May 1979, Table 41	Normalized to a Sqdn/Yr

TABLE 9. RELIABILITY AND MAINTAINABILITY ANALYSIS

		Reliability (MFHBF)			Maintainability (DMMH/FH)		
WUC	ELEMENT	F-4E	FX	SCALAR	F-4E	FX	SCALAR
11	Airframe	15	54	.28	3.02	2.40	.79
12	Fuselage Compartments	50	98	.51	.52	.34	.65
13	Landing Gear	11	15	.73	2.38	2.02	.84
14	Flight Controls	18	19	.96	1.86	1.27	.68
23	Engine	28	33	.85	3.51	3.19	.91
41	Air Cond,Pres, Ice	38	38	1.00	.63	.63	1.00
42	Electrical System	44	67	.66	1.31	1.24	.95
44	Lighting	36	48	.75	.72	.58	.81
45	Hydraulic/Pneumatic	50	38	1.30	.58	.37	.64
46	Fuel System	41	48	.85	.92	.61	.66
47	Oxygen System	73	73	1.00	.08	.08	1.00
51	Instruments	64	107	.60	1.07	.80	.75
56	Flight Reference	91	126	.73	.08	.06	.67
57	Int Guidance/Flt Cont	105	140	.75	1.39	.97	.70
67	Comm/Nav IFF (other)	50	74	.68	.89	.62	.70
67x	UHF Comm	19	22	.86	1.63	1.34	.82
71	Radio Nav	461	823	.56	1.06	.74	.70
72	Radar Nav	145	184	.79	.50	.34	.68
73	Bomb Nav (other)	35	37	.95	.50	.34	.68
73x	Bomb Nav Radar	29	81	.36	2.79	2.09	.75
74	Weapons Cont (other)	32	42	.77	.55	.37	.67
74xx	AGM-XX Cont	9	18	.50	2.90	2.32	.80
75	Weapons Delivery	36	36	1.00	.83	.83	1.00
76	ECM	58	58	1.00	.36	.36	1.00
49,77,91, 92,93,96, 97	Misc	94	94	1.00	.60	.60	1.00
		1.28	1.77	.72	30.68	24.51	.80

3.3.1.1 Airframe.

The FX is composed of 53% composite material. This is expected to greatly increase the reliability of non critical aircraft components; however, each failure must be expected to require more manhours to repair than current alloys. The increased DMMH per failure will be more than offset by the increased reliability, thereby reducing the DMMH/FH . . . .

3.3.1.2 Fuselage.

See paragraph 3.3.1.1 above.

GUIDANCE: DATA FOR THE BASELINE SYSTEM IS USUALLY AVAILABLE TO THE FIVE DIGIT WORK UNIT CODE BREAKOUT, HOWEVER, IT MAY NOT BE AVAILABLE ON THE ALTERNATIVE SYSTEM, OR THE FIVE DIGIT LEVEL OF DETAIL MAY NOT BE APPROPRIATE/SIGNIFICANT. THEREFORE, THE DATA SHOULD BE CONSOLIDATED TO A SIGNIFICANT LEVEL OF DETAIL. THE RATIONALE USED IN DEVELOPING THE WUC SCALARS SHOULD BE BRIEFLY EXPLAINED.

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3.3.2 Material Costs Scalar.

The material cost scalar of the FX system is 2. Derivation follows:

a. F-4E Procurement: (In Millions)

Year	Costs			Qty	Unit Flyaway Cost
	Actual	Escalation Rates	FY80$		(FY80$)
1970	73.4	2.30	168.8	27	6.25
1971	76.5	2.17	166.0	30	5.54
. . .	. . .	. . .	. . .	. . .	. . .
1977	222.3	1.22	271.2	30	9.04
1978	238.0	1.13	268.9	30	8.96

Average Unit Flyaway Costs = $6.71

b. Labor portion of flyaway costs is not scaled.

c. Material Costs

(1) F-4E = 38% of flyaway costs
= .38 x 6.71 = $2.55M

Percentage is based on contractor documentation, available from (list Project Officer, Office symbol, extension).

(2) FX System = $10.6M = Flyaway Costs (assumed)

The increase in flyaway costs is due to historical cost trends, increased performance requirements, use of advanced technology, and increase in the percentage of overhead due to lower production rates.

Material Costs = 50% of flyaway
= .50 x $10.6 = $5.3M

The increase in percentage of flyaway costs is based on the use of expensive composite material in the air frame and the use of micro-electronics.

d. Material Cost Scalar

= FX System Mat ÷ F-4E Mat

= $5.3 ÷ $2.55

= 2

GUIDANCE: MANY OF THE ALTERNATIVE SYSTEM O&S COSTS WHICH CANNOT BE OBTAINED DIRECTLY MAY BE ESTIMATED BY DETERMINING THEIR RELATIONSHIP TO THE TOTAL COSTS OF THE BASELINE SYSTEM. REPLENISHMENT SPARES AND COMPONENT REPAIR ARE BUT TWO EXAMPLES OF SUCH COSTS. THEREFORE, IT IS OFTEN HELPFUL TO ESTABLISH A RELATIONSHIP BETWEEN THE BASELINE COSTS AND THE ESTIMATE OF THE ALTERNATIVE SYSTEM'S FACTORS COSTS.

3.3.3 Design/Environment Impact.

Based on a study of maintenance actions covering fighter/attack aircraft, subject: . . . dated . . ., it was found that 78% of the structural failures could have been avoided by redesign . . . as such, the assumption is made that . . . is the applicable factors . . . .

GUIDANCE: WHEN APPLYING ESTIMATING FACTORS TO A GIVEN COST, THAT COST CAN SOMETIMES BE SEPARATED INTO TWO PARTS: THOSE WHICH ARE RELATED TO THE DESIGN OF THE COMPONENT IN QUESTION AND THOSE WHICH ARE CONSTANT. INDUCED FAILURES, FALSE REMOVALS, STORAGE AND HANDLING LOSSES ARE EXAMPLES OF CONSTANT COSTS WHICH ARE NOT DIRECTLY DESIGN-RELATED. THESE COSTS SHOULD BE CONSIDERED SEPARATELY IN ORDER TO DETERMINE THE TOTAL COST ESTIMATE.

3.4 Like and Similar (L/S) Hardware List.

The technical basis of the improved, FX component repair and replenishment spares cost estimates is a bottoms-up cost factor estimation technique. This technique was facilitated by an analysis recently completed of a total set of functional analogies to the FX 5 digit WUC hardware related to existing aircraft with adequate reliability and maintainability data bases . . . .

These functional analogies are considered valid for costing only and are not intended to replicate the performance characteristics of FX equipment . . . .

A listing of Like and Similar equipment is contained in Appendix B.

3.5 POL Consumption.

There are four basic mission profiles anticipated for the FX. They are as follows . . . . Table 10 reflects the approximate percentage for each type sortie and the Petroleum, Oils, and Lubricants (POL) consumptions rates . . . .

TABLE 10. POL CONSUMPTION

Mission	Total, Sorties	Duration	POL	POL/FH
A	10%	4.0 hr	2780 gal	695 gal/FH
B	20%	2.5 hr	1750 gal	700 gal/FH
C	40%	1.0 hr	712 gal	712 gal/FH
D	30%	1.5 hr	1059 gal	706 gal/FH

Average Sortie Duration

A	10%	x	4.0 hr	=	0.4 hr
B	20%	x	2.5 hr	=	0.5 hr
C	40%	x	1.0 hr	=	0.4 hr
D	30%	x	1.5 hr	=	0.45 hr
			Average		1.75 hr

% of Total Fly Hours

A	0.4 hr	÷	1.75 hr	=	22.9%
B	0.5 hr	÷	1.75 hr	=	28.5%
C	0.4 hr	÷	1.75 hr	=	22.9%
D	0.45 hr	÷	1.75 hr	=	25.7%

Contribution to Average POL Consumption

A	22.9%	x	695 gal	=	159.2 gal
B	28.5%	x	700 gal	=	199.5 gal
C	22.9%	x	712 gal	=	163.0 gal
D	25.7%	x	706 gal	=	181.4 gal
			Total		703.1 gal/FH

GUIDANCE: WHEN THE DERIVATION OF A VALUE USED IN THE COST ANALYSIS IS COMPLEX, PROVIDE A DETAILED EXPLANATION.

4. SENSITIVITY/RISK ANALYSIS

Although the FX system has not been deployed there is sufficient detail known to establish fairly accurate predictions. This coupled with a well-established and accurate data base provides a credible basis for the estimations . . . .

GUIDANCE: INCLUDE AN INDICATION OF THE CONFIDENCE IN THE FIGURES PRESENTED.

4.1 General.

Airframe Rework, Reliability and POL appear to present the greatest risk potential . . . .

GUIDANCE: DEVELOP A FURTHER, DETAILED ANALYSIS OF THE COST IMPACT OF EACH COST ELEMENT OFFERING A POTENTIAL FOR HIGH COSTS, ESPECIALLY THOSE OF WHICH THE VALUE ESTIMATED FOR THE O&S COST ANALYSIS COULD VARY WIDELY. IDENTIFY THE RANGE OF VALUES SELECTED FOR SENSITIVITY ANALYSIS AND THE RATIONALE FOR SELECTION. PRESENT THE RESULTS USING IDENTICAL GRAPHICAL VALUES WHENEVER POSSIBLE TO FACILITATE A COMPARISON.

4.2 Airframe Rework.

Programmed Depot Maintenance (PDM) costs were developed by the contractor using . . . .

. . . . The estimates were then compared with current aircraft rework costs with the following results:

Acft	Costs Per PDM
F-15A	$633.24 K
F-4E	$409.73 K
FX	$350.00 K
F-105	$284.34 K
F-106	$264.54 K
F-16	$239.47 K
F-5E/F	$149.97 K
A-7D	$128.57 K

Although there is little data on depot maintenance of aircraft with a high percentage of composite material, the estimate appears . . . .

The $650 K per PDM high value and $240 K low value were selected for their sensitivity analysis because . . . .

	PDM Cost Range		
Cost/PDM	$240 K	$350 K	$650 K
Annual Cost/Sqdn difference	-$264 K	0	+$720 K

4.3 Reliability.

The range of reliability values was based on a review of the potential of each subsystem . . . Table 11 identifies the high potential and low values for each subsystems's reliability . . . .

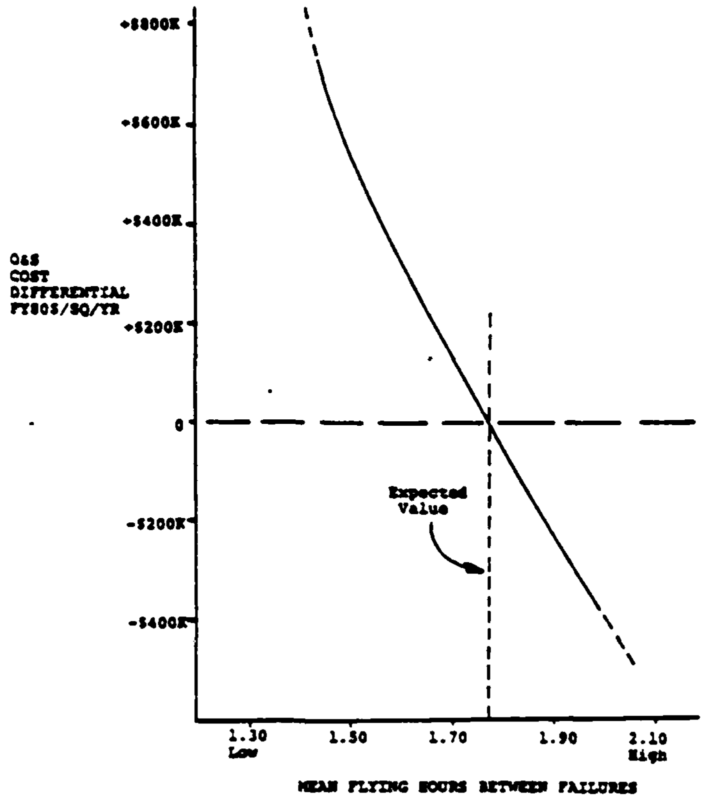
TABLE 11. RELIABILITY SENSITIVITY

Work Unit Code	Mean Flying Hours Between Failures		
	Low Hours	Expected Hours	High Hours
11	25	54	80
12	75	98	107
13	11	15	19
14	18	19	27
23	23	33	37
41	38	38	38
42	65	67	70
44	45	48	50
45	32	38	47
46	41	48	58
47	73	73	73
51	75	107	160
56	121	126	138
57	136	140	142
67	63	74	78
67x	20	22	22
71	750	823	930
72	184	184	196
73	35	37	38
73x	30	81	90
74	40	42	49
74xx	12	18	26
75	36	36	36
76	58	58	58
49, 77, 91, 92 93, 96, 97	94	94	94
Total System	1.42	1.77	2.05

Cost Delta

	Low Hours	Expected	High Hours
Maint Material	+ 329	-	- 164
Component Repair	+ 334	-	- 182
Replenishment Spares	+ 176	-	- 97
Total	+$839	-	-$443

SUBSYSTEM RELIABILITY



DEPOT AIRFRAME REWORK (PDM)

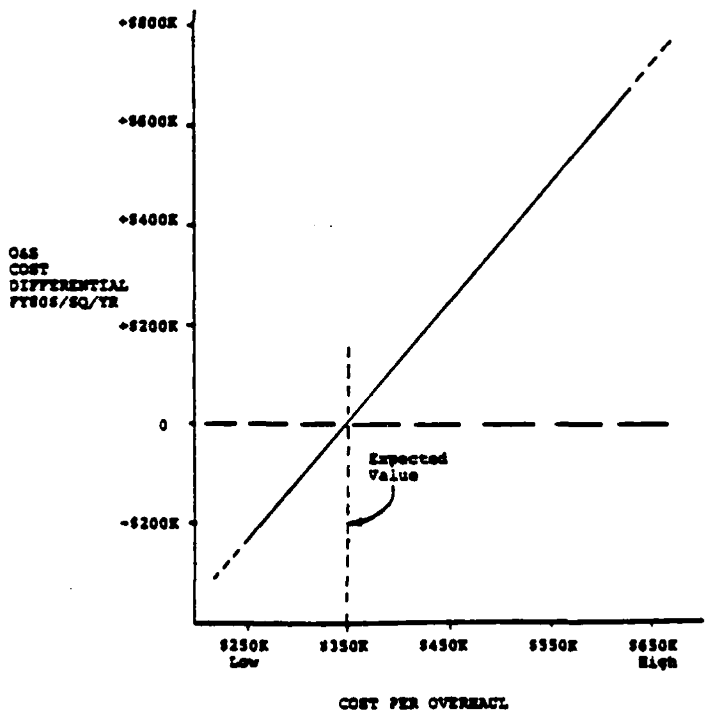


FIGURE 2. SENSITIVITY GRAPHS

4.4 POL Sensitivity.

There are two areas of risk associated with POL costs: the uncertainty of unit costs and the fuel consumption of a new weapon system . . . . To place the FX system in the proper perspective, other comparable weapon systems are shown in Figure 3 . . . . (Figures are taken from AFP 173-13 dated 1 Feb 1980.) Based on 290 FH/PAA/YR.

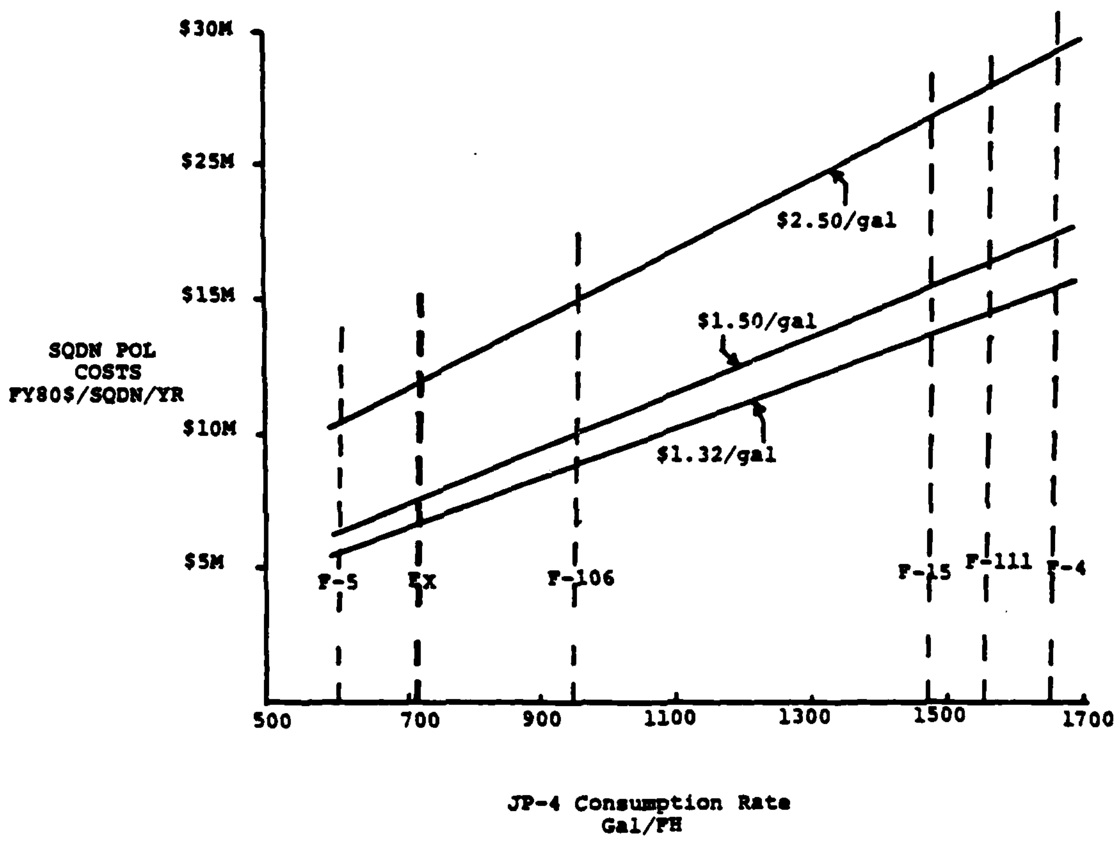


Figure 3. POL Sensitivity Graph

5. SUMMARY

Still to be resolved are the methods of determining and prorating Miscellaneous Operations and Maintenance and Second Destination Transportation Costs. It is anticipated that these methods will be developed and values for these indirect categories validated in the near future.

GUIDANCE: NOTE ISSUES LEFT UNRESOLVED OR THOSE WHICH WILL RECIEVE CLOSE SCRUTINY IN THE FUTURE.

APPENDIX A. UNIT MAINTENANCE PERSONNEL

A.1 General: Since the smallest divisible unit in peacetime is the Tactical Fighter Wing, the wing figures are shown. However, manning for the Unit Type Code (UTC), which is the deployable squadron size unit, are also shown. It is these figures that are used in this costing analysis. . . .

A design that focuses on greater flexibility and quicker turnaround time will allow for increased aircraft utilization. It is expected that . . . . The use of redundency in avionics down to the circuit board level will . . . . Further, the greater use of composite material will . . . .

GUIDANCE: EXPLAIN THE RATIONALE BEHIND MANNING CHANGES TO THE BASELINE SYSTEM. WHEN THE ALTERNATIVE SYSTEM INCORPORTATES NEW CONCEPTS OR A RADICAL DEPARTURE FROM EXISTING SYSTEMS/METHODS, EXPLAIN IN DETAIL THE CHANGE AND ITS EXPECTED IMPACT ON MANNING. THIS EXAMPLE FOCUSES ON THE MAINTENANCE ORGANIZATION. THIS DOES NOT IMPLY THAT THE MANPOWER ISSUE WILL ALWAYS BE MAINTENANCE.

A.2 Aircraft Generating Squadron.

The 16% decrease in maintenance technicians reflects the increase in subsystem reliability and the greater use of built in tests (BIT) which simplify and expidite fault finding. . . .

A.3 Equipment Maintenance Squadron.

Emphasis during the system design was placed on increased structural integrety and ease of maintenance. . . . The modularity of the aircraft, as well as the engine, will . . . . The use of composite material is especially evident in the manning of the corrosion control function. . . .

A.4 Component Repair Squadron.

The implementation of the Depot circuit board repair facility has shifted the workload from the intermediate shops to . . . .

GUIDANCE: INCLUDE A DETAILED NARRATION OF FACTORS THAT IMPINGE ON MAINTENANCE MANNING, SUCH AS CAPACITY OF FACILITIES, THROWAWAY VS. REPAIR IMPACT, AND MAINTENANCE CONCEPT.

TABLE A.1 UNIT MAINTENANCE PERSONNEL

TITLE	F-4E Wing Off	F-4E Wing Enl	F-4E UTC Off	F-4E UTC Enl	FX Wing Off	FX Wing Enl	FX UTC Off	FX UTC Enl
Chief of Maint.	4	51			4	51		
Quality Cont.	2	30			2	25		
Maint Con.	3	71			3	57		
Acft Generation Sq.	9	660	3	220	9	553	3	184
Sqdn Mgmt	3	38			3	38		
Acft Maint.	6	51			6	43		
Acft		201				162		
Specialists		195				154		
Weapons		168				150		
Support		7				6		
Equip Maint Sqdn	6	388	2	129	6	322	2	107
Sqdn Mgmt	3	12			3	12		
AGE		84				42		
Maint	1	2				2		
Inspection		27				21		
Corrosion Cont.		8				3		
Fuel Systems		21				21		
Repair & Reclama		27				27		
Egress		29				29		
Munitions Equip Maint		8				8		
Line Delivery		44				34		
Material Production		4				4		
Munitions	1	3			1	3		
Munitions Cont.		7				7		
Armament Systems		44				44		
Conventional Mun Maint		19				19		
Missile Maint.		15				15		
Munitions Maint S&H		25				25		
Munitons Inspection		6				6		
Component Repair Sqdn	6	304	2	101	6	236	2	79
Sqdn Mgmt	3	10			3	10		
Conventional Avionics	1	2			1	2		
Comm/Nav		9				5		
Auto Flt Cont. Inst		8				5		
Inertial Nav System		5				4		
Photo		7				7		
Sensors		17				12		
Electric		5				5		
Electronic Warfare		78				46		
Weapons Cont Systems		36				29		

TITLE	F-4E				FY			
	Wing		UTC		Wing		UTC	
	Off	Enl	Off	Enl	Off	Enl	Off	Enl
Avionics AGE		10				10		
Propulsion	1	3			1	3		
Jet Engine		65				51		
Accessory Maint	1	2			1	2		
Metal Processing		6				3		
Structural Repair		5				8		
Survival Equip		10				10		
Machine Shop		8				8		
Pneudraulics		6				6		
Environmental Systems		4				4		
NDI		8				6		
TOTALS								
Chief of Maint	4	51			4	51		
Quality Control	2	30			2	25		
Maint Control	3	71			3	57		
Acft Generating Sq	9	660	3	220	9	553	3	184
Equip Maint Sq	6	388	2	129	6	322	2	107
Component Repair Sq	6	304	2	101	6	236	2	79
GRAND TOTAL	30	1504	7	450	30	1244	7	370

APPENDIX B

LIKE AND SIMILAR (L/S) WORK UNIT CODES (WUC)

FX WUC	L/S M/D/S	L/S WUC	L/S NOM
			11000 Air Frame
11A1	A-7D	114	Wing
11C1	F-15A	115	Emppennage
1111	A-7D	111	Forward Fuselage Section
1131	F-4E	1115	Center Fuselage
1151	F-15A	1131/2/3/4/A	Aft Fuselage
1171	F-15A	11143/4 & 1116M/N/9	Fwd Fuselage Structures
			12000 Fuselage Compartments
1211	F-16A	1251	Cockpit Equipment
122A	F-15A	1211	MK GRU7 Ejection Seat (half value)
1251	F-4E	123	Canopy Systems
			13000 Landing Gear
13C1	A-7D	131	Main Landing Gear
13C1	F-4E	1325	MLG Wheels/Tires
13C2	A-7D	132	Nose Landing Gear
13C2	F-4E	1352	NLG Wheels/Tires
13C3	F-16A	1345	Landing Gear Control
13C4	F-16A	1345	Landing Gear Emergency Control
13C50	F-16A	1381-13819	Wheel Brake System
13C51	F-16A	13819	Wheel Brake Mechanical Componenets (NOC)
13C52	F-16A	1382-13829	Wheel Brake Hydraulic
13C53	F-16A	1383-13839	Wheel Brake Electrical
13C541	F-16A	13852	DCU179/A Aircraft Skid Control
13C542	F-16A	13853	Skid Control Valve
13C543	F-16A	13859	NOC
13C544	F-16A	13859	NOC
13C55	F-4E	1342	Emergency Brake Control
13C59	F-16A	13829/13839	Wheel Brake - NOC
13C6	F-16A	1334	Nose Wheel Steering

FX WUC	L/S M/D/S	L/S WUC	L/S NOM
			14000 Flight Controls
1411	F-4E	14111/B & 14322 & 14428	Flight Controls
1421	F-4E	142/428C5	Roll Control System
1431	F-16A	144	Longitudinal Control System
1441	F-16A	143	Directional Control System
1451	A-7D	147	Flap System
1461	A-7D	147	Flap System
1471	A-7D	146	Speed Brake System
			23000 Turbofan Engines
23000	F-15A	23000	See Appendix C
			41000 Air Cond/Prsrz/ Surface Ice Control
4111	F-4E	4123	Bleed Air System
4112	F-4E	4111	Cabin Air Conditioning
4113	A-7D	41117/N & 41126/7	ECS Components
4115	A-7D	4112	ECS Refrig. Installation
4117	F-4E	4171	Radar Coolant System
41211	F-4E	4124	Canopy Seal Pressurization
41212	F-4E	4122	Radar Compartment Pressurization
41213	F-4E	4141	Anti-G Components
41214	F-4E	4133	Pressure/Vent/G Suit System
4131	F-4E	4132	Rain & Ice Removal System
4131	A-7D	4116	Defogger System
41215	F-4E	41127	Ground Ejector Valve

FX WUC	L/S M/D/S	L/S WUC	L/S NOM
			42000 Electrical Systems
4211	F-15A	4211	AC Generator System
4231	F-15A	4213	DC Components
4241	F-15A	4231	Circuit Breaker Panels
4251	A-7D	4241	External Power Supply System
4251	A-7D	42854	External Power Aircraft Wiring
428J	A-7D	42853	Power DIstribution Aircraft Wiring
4280	F-15A	Various	Systems Wiring
4280	F-15A	428	Systems Wiring
			44000 Lighting System
44000	F-16A	44000	Lighting System
			45000 Hydraulic/Pneumatic Power
4531	F-15A	4511	Hydraulic Power Control #1
4541	F-15A	4512	Hydraulic Power Control #2
			46000 Fuel Systems
4611	F-15A	4611	Internal Fuel System
4621	F-15A	4621	External Fuel System
4631	F-16A	4631	Aerial Refueling System
4641	F-16A	4641	Fuel Control Indicating/ Warning
			47000 Oxygen Systems
47000	F-4E	47000	Oxygen Systems
			49000 Miscellaneous Utilities
4911	F-16A	49D	Fire Detection System
4921	F-16A	49x11/2	ID1758/9 Advisory Ind. Panels
4941	A-7D	23DB6	P-5 Air Probe
4942	F-4E	4913	Bleed Air Leakage Detection System
4943	F-4E	73A22	C7830/ASN91 Tac Cmptr Control
4943	F-16A	122218	Jettison Panel

FX WUC	L/S M/D/S	L/S WUC	L/S NOM
			51000 Instruments
5111A	F-15A	51212	AQU5/A Standby Compass
5111B	F-15A	51131	AVU24/A Airspeed Mach. No. Ind.
5111C	F-15A	51353	AEU11/A Eng. Rotor Overspeed Detector
5111D	A-7D	5111C	Hydraulic Pressure Indicator
5111E	F-16A	51521	EFU34/A Liquid Quantity Indicator
5111F	F-111E	5111B	Lox Ind.
5111G	F-16A	51541	Brake Pressure Ind.
5111J	F-16A	51133	Vertical Velocity Ind.
5111L	F-111E	51523	ECU74/A Signal Data Converter
51110	F-15A	Various	51000 "NOC" codes
51114	F-16A	41213	Cockpit Pressure Altimeter
51115	F-16A	51111	AAU19/A Counter Drum Altimeter
51117	F-16A	51610	FPT Control/Landing Gear Posn. Ind.
51118	F-15E	51211	ABU 11/A Clock
51141	F-4E	51136	Pitot Static Tube
51144	F-4E	51141	Pitot Static Probes
51145	F-4E	51138	Pitot Heater
			56000 Flight Reference
5645K	A-7D	56292	Total Temperature Probe
56x28	F-15A	56x25	CP1166/A Air Data Computer
56x2A	F-15A	56x1D	TRU 143/A Angle of Attack Transmitter
56x31	F-15A	564E0	DSU4( )/A High Temp Mag Az Detector
56x35	F-4E	56x14	ARU13A FLT Reference Indicator
56x2B	F-16A	564E2	TRU 79/A Induction Transmitter
56x2C	F-16A	564E1	MXU 394/A Electronic Compensator
56000	F-16A	564E9/56x29	NOC
			57000 Integrated Guidance/ Flight Control
57D91	F-15A	52AA/52AB	Flight Control Computer
57D91	F-16A	5771	AN/ASW32 Automatic Flight Control Set
57D93	A-7D	57574	Stick Force Transducer
57x1L	A-7D	57574	" " "
57D92	F-16A	52AH0	Engaging Controller
57D92	F-16A	573E1	C8821/ASW37 WG/Flap/Glove Vane Control
57D97	F-15A	52AM0	Dynamic Pressure Sensor
57D97	F-16A	57Y12	CP 1270/A Trim Computer
57D90	F-16A	573E9	NOC
57D94	F-16A	14241	Lateral Transducer

FX WUC	L/S M/D/S	L/S WUC	L/S NOM
			67000 Comm Nav, IFF
6741	F-15A	6723	KY28 Encoder
67R1	F-15A	63Y1W	C8057/ARC Security Voice Control
67x21	A-7D	64354	Converter Intercomm. Box
67x22	F-16A	71AKO	Nav. Control-Indicator
67x22	F-16A	67181	C4850 ( )/ASQ85(V) IEC Control
67x24	A-7D	67x1D	AS1704 ( )/U Antenna
67x25	A-7D	67x1C	F339/A Band Pass Filter
			71000 Radio Navigation
71D11	F-16A	71D11	R1379 ( )/ARA63 Radio Reciever
71D12	F-16A	71D12	KY651 ( )/ARA63 Pulse Decoder
713V	F-16A	7143	AN/ARN52
71Y92	F-16A	7143	"
71D18	F-16A	71D17	AS2800/ARA63 Antenna
71Y91	F-16A	7116	ARA50 Direction Finder Group
			72000 Radar Navigation
722B1	F-15A	722B1	RT1015 ( )/APN194(V) Reciever Transmitter
722B4	F-15A	722B4	AS25995/APN194(V) Antenna
729D1	A-7D	729D1	RT1028/APN202 Reciever Transmitter
72Y1F	F-15A	72Y1F	R1623/APN Reciever
72Y1W	F-15A	722B5	1D1768 ( )/APN194(V) Height Indicator
72Y1H	A-7D	72Y1G	AS2406/APR Antenna
722B9	F-16A	722B9	AN/APN194(V) NOC
729D0	EF-111E	72929	AN/APN202 NOC
			73000 Bombing Navigation
73M10	F-15A	734H9	AN/ASN 92(V) NOC
73M11	F-15A	734H1	CN1263/ASN92(V) IMU #1
73x32	F-15A	69161	IP1032/ASA79 Multi Display Ind.

FX WUC	L/S M/D/S	L/S WUC	L/S NOM	
			74000 Weapons Control	
74D61	A-7D	73A41	IP946/AVQ7 HUD UNIT	
74L1	F-4E	7611	AN/AAA 4 Infrared Detecting Set	
74L1	F-4E	7432	AN/APQ72 Radar	
74N11	A-7D	74Y1B	C8185/AWE Armament Station Control	
74N13	F-16A	743D5	KY694 CMD. Signal Encoder/Decoder	counted
74N14	F-16A	743D5	KY694 CMD. Signal Encoder/Decoder	each
74N17	F-16A	743D5	KY694 CMD. Signal Encoder/Decoder	time
74N15	F-16A	743D4	KY695 CMD. Signal Encoder/Decoder	
74R61	F-15A	74R12	Air Combat Maneuver Panel	
74R64	F-4E	74997	Inflight Monitor/Control Panel	
74116	F-15A	74R19	NOC	
7415C	EF-111E	73B1	AN/AYK-10(V) Digital Computer	
742G	F-4E	7427	AN/APG59(R) Radar	
74680	F-15A	69169	AN/ASA79 NOC	
74681	F-15A	69161	IP1032/ASA79 Multi-Display Indicator (cost picked up at 73x32)	
74683	F-15A	69163	C8573/ASA79 Control Power Supply	
748E1	A-7D	748E	AN/AWW5 (V)Fuse Factor Control Set	
749T2	A-7D	749T	AN/AWG25 Missile Control System	
			75000 Weapons Delivery	
751B4	A-7D	751B4	Aero 5 ( ) Guided Missile Launcher	
751B6	A-7D	751B6	LAU7 ( ) Guided Missile Launcher	
751BE	F-4E	751BA	LAU93 Guided Missile Launcher	
751BJ	F-4E	751B8	LAU92 Guided Missile Launcher	
754CD	A-7D	754BM	BRU 10 Bomb Ejector Rack	
754CE	A-7D	754BL	BRU 9 Bomb Ejector Rack	
75E5	F-4E	1125	Multi-Purpose Pylon Installation	
75H6	F-4E	75H6	M61A1 Aircraft Gun Installation	
75000	F-4E	75000	NOC	

FX WUC	L/S M/D/S	L/S WUC	L/S NOM
			76000 Electronic Countermeasures
7665	F-4E	7665	AN/ALE29 ( ) Chaff Dispensing Set
766M	F-4E	766M	AN/ALE39 ( ) Chaff DIspensing Set
767L	A-7D	767L	RT1079/ALQ126 Reciever Transmitter
76R5J	F-4E	76R5J	HB Antenna (ALQ126)
76R5K	F-4E	76R5K	MB Antenna (ALQ126)
76R5L	F-4E	76R5L	LB Antenna (ALQ126)
76R5V	A-7D	76R6L/M	Rigid & Flexible Waveguide Components
76x45	F-4E	76x44	MX9467/A Interference Blanker
76x4A	A-7D	7666C	Aft Radome
76x4C	A-7D	767J5	AS2716/ALQ120 Antenna Radome
76x4D	F-4E	76R5D	H-B Coupler (ALQ126)
76R59	F-4E	76R59	NOC
76x40	F-4E	76x49	NOC
			77000 Photo/Recon
77A58	F-4E	77A52	KB23A Motion Picture Camera
			91000 Emergency Equipment
91A5F	F-4E	91A58	SKU-2A Seat Survival Kit
91A50	F-4E	91A59	NOC
91114	A-7D	91A5A	Life Raft
91115	A-7D	91A2	Parachute
			97000 Explosive Devices
97000	F-4E	97000	Maint. Actions and $ reduced 50% to account for second seat extras. Only available at 2 digit level

APPENDIX C

FX Engine Repair Costs

At the previous Program Review (March 1980), an O&S cost estimate of the FX engine was presented based on data supplied by the manufacturers. This estimate was noted as an area of major concern during the review.

Since that time a study was performed comparing the FX engine to the J-79 engine. This study resulted in a better estimate of the Operating and Support costs (especially at the Depot level) for the new modular engine. The report is entitled, Report for Operating and Support Cost Estimating Factors (Modular Gas Turbine Engines), 10 May, 1980.

The basic approach was to estimate the O&S cost of the FX engine and compare it to the J-79. Individual elements of the J-79 O&S costs were regrouped to form modules similar to the FX engine modules, as shown in Figure C-1.

The Depot level costs calculated refer to the repairs of the engine modules plus repair of whole engines sent to the Depot. Selected Depot reports were used to determine the Depot labor, material and overhead costs for engine repairs. These costs for the J-79 were applied to the manhour data supplied by the contractor to arrive at estimates of engine module repair and whole engine repair which was then normalized to a dollar per flight hour value of $103.86/FH (FY-80$).

FX MODULE DEFINITION

MODULE NAME	J-79 COMPONENETS PARTS
Fan Module (LPC)	Front frame Fan stator assembly Fan rotor assembly Varible geometry actuation system
High Pressure Compressor Module (HPC)	Midframe High pressure compressor stator High pressure compressor rotor assembly
Combustor Module (CB)	Combustor casing Combustor liner High pressure turbine nozzle assembly
High Pressure Turbine Module (HPT)	High Pressure turbine rotor
Low Pressure Turbine Module (LPT)	Low pressure turbine casing Low pressure nozzles Exhaust frame Mounting ring Low pressure turbine rotor
Afterburner Module (A/B)	Varible exhaust nozzle assembly and actuators Afterburners assembly
Lower Duct and Engine Accessories Module (Duct & AE)	Lower duct (for bypass air) Accessory gearbox Main fuel system Afterburner fuel system Lubrication system Electrical system Bleed air system

FIGURE C-1

APPENDIX D. MATHEMATICAL COMPUTATIONS

(All results in Thousands)

GUIDANCE: PROVIDE THE MATHEMATICAL COMPUTATIONS AND FORMULAS/ ALGORITHMS USED TO CALCULATE THE COST ELEMENTS. DO NOT DUPLICATE COMPUTATIONS PERFORMED IN MECHA-IZED (COMPUTERIZED) MODELS DESCRIBED IN APPENDIX E.

UNIT MISSION PERSONNEL
(AFP 173-13, Table 27 & 30)

F-4E BASELINE

Aircrew

Aircrew x rate = off costs
30 x $28,167 = 845K/sq/yr

Maintenance

Maint off x rate = Maint off costs
7 x $25,752 = $180.2K
Maint enl x rate = Maint enl costs
450 x $11,730 = $5,278.5K
Maint off + Maint Enl = Total cost
$180.2K + $5278.5K = $5,459K/sq/yr

Other Unit Personnel

off x rate = off cost
35 x $25,752 = $901.3K
enl x rate = enl cost
56 x $11,730 = $656.9K
off + enl = Total cost
$901.3K + $656.9K = $1,558K/sq/yr

FX

Aircrew x rate = off costs
30 x $28,167 = $845K/sq/yr

Maint off x rate = Maint off cost
7 x $25,752 = $180.2K
Maint Enl x rate = Maint Enl cost
370 x $11,730 = $4,340.1K
Maint off + Maint Enl = Total cost
$180.2K + $4340.1K = $4520K/sq/yr

off x rate = off cost
35 x $25,752 = $901.3K
enl x rate = enl cost
56 x $11,730 = $656.9K
off + enl + Total cost
$901.3K + $656.9K = $1,558K/sq/yr

UNIT LEVEL CONSUMPTION

POL

F-4E Baseline:
Consumption rate x FH/PAA x PAA x cost
1662 gal x 290FH x 24acft x $1.50/gal =
$17,351K/sq/yr

FX:
Consumption rate x FH/PAA x PAA x cost
703 gal x 290FH x 24acft x $1.50/gal =
$7,339K/sq/yr

F-4E	FX

Maintenance Material (AFP 173-13, Table 1)

F-4E	FX
cost/FH x FH/PAA x PAA $228 x 290FH x 24 acft $1,587K/sq/yr	baseline x reliability scalar x material cost scalar $228/FH x .69 x 2 = $314.64/FH cost/FH x FH/PAA x PAA $314.64 x 290FH x 24 acft $2,190K/sq/yr

Training Ordinance (AFP 173-13, Table 7)

	F-4E Mission Support	FX Mission Ready	FX Mission Support
Air to Ground	$38,381	$68,558	$29,425
Air to Air	2,987	11,425	1,680
Air to Air (Intercept)	3,640	14,662	3,640
Total	$75,008	$94,645	$34,745

F-4E	FX
Crews x Mission Spt = Ord costs 30 x $75,008 = $2,250K/sq/yr	Crews [Mission ready + (Mission support x 14 yrs) ÷ 15 yrs]= ave annual costs 30 [($94,645 + ($34,745 x 14)) + 15] $1,162K/sq/yr

Note: Aircrew attrition considered offsetting.

Table D.1 Subsystem Costing (F-4E Baseline)

Component Repair & Replenishment Spares

WUC	Subsystem	Comp Repair	Rep. Sp
11	Airframe	8.04	4.26
12	Fuselage Comp.	.99	.25
13	Landing Gear	20.80	16.41
14	Flt Controls	14.10	9.13
23	Engine	77.03	17.33
41	Air Cond, Press, Ice	10.52	6.81
42	Elec System	9.15	.89
44	Lighting	.41	1.18
45	Hyd/Pneu	6.08	1.71
46	Fuel System	2.89	.36
47	Oxygen Sys	1.23	1.13
51	Instruments	9.11	.39
56	Flt Reference	10.76	.15
57	Int Guide/Flt Cont	3.86	.63
67	Comm/Nav, IFF (other)	2.83	1.29
67X	UHF Comm	6.79	3.15
71	Radio Nav	1.71	.08
72	Radar Nav	8.37	.56
73	Bomb Nav (other)	2.99	1.13
73X	Bomb Nav (Radar)	4.29	2.06
74	Weapons Cont	15.61	9.03
74XX	AGM-XX Cont	60.16	25.14
75	Weapons Delivery	8.56	1.15
76	ECM	4.16	1.06
49,77, 91,92, 93,96, 97	Misc	4.68	3.03
	Total	$295.12/FH	$108.31/FH

Table D.2 Bottoms-Up Costing (FX Aircraft)

		Component Repair & Replenishment Spares (See Appendix B)	
WUC	Subsystem	Comp Repr	Rep Sp
11	Airframe	4.31	1.58
12	Fuselage Comp	.86	.32
13	Landing Gear	21.71	7.97
14	Flt Controls	17.78	6.53
23	Engine	99.85	36.65
41	Air Cond, Press, Ice	10.52	3.86
42	Elec System	9.83	3.61
44	Lighting	.38	1.14
45	Hyd/Pneu	9.27	3.40
46	Fuel Systems	3.39	.24
47	Oxygen Sys	1.23	.45
51	Instruments	7.48	2.75
56	Flt Reference	10.30	3.78
57	Int Guide/Flt Cont	3.67	1.35
67	Comm/Nav, IFF (other)	2.71	.99
67X	UHF Comm	7.34	2.69
71	Radio Nav	1.31	.48
72	Radar Nav	8.34	3.06
73	Bomb Nav (other)	3.00	1.11
73X	Bomb Nav (Radar)	2.58	.95
74	Weapons Cont	12.82	4.70
74XX	AGM-XX Cont	45.44	16.68
75	Weapons Delivery	8.56	3.14
76	ECM	4.16	1.52
49,77, 91,92, 93,96, 97	Misc	4.68	1.72
	Total	$301.52/FH	$110.67/FH

F-4E FX

Depot Level Maintenance

Airframe Rework (PDM)

F-4E	FX
cost/PDM ÷ PDM interval	cost/PDM ÷ PDM interval
x 12 months = costs/PAA	x 12 months = costs/PAA
cost/PAA x 24PAA = sqdn costs	cost/PAA x 24PAA = sqdn costs
$409.73K ÷ 55 mo	$350K ÷ 89.5 mo
x 12 mo = $89.4K/acft/yr	x 12 mo = $46.9K/acft/yr
$89.4K x 24PAA = $2145.4K/sqdn/yr	$46.9K x 24PAA = $1,126.3K/sqdn/yr

F-4E	FX
Engine Rework	
cost/FH x FH x PAA = sqdn costs $173.55 x 290FH = $50.3K/acft/yr $50.3K x 24PAA = $1207.9K/sqdn/yr	See appendix C cost/FH x FH x PAA = sqdn costs $103.86 x 290FH/PAA = $30.1K/acft/yr $30.1K x 24PAA = $722.9K/sqdn/yr
Component Repair	
See table D.1 $295.12/FH x 290FH = $85.6K/acft/yr $85.6K x 24PAA = $2,054K/sqdn/yr	See table D.2 $301.52/FH x 290FH = $87.4K/acft/yr $87.4K x 24PAA = $2,099K/sqdn/yr

Sustaining Investment

F-4E	FX
Replenishment Spares	
See table D.1 $108.31/FH x 290FH = $31.4K/acft/yr $31.4K x 24PAA = $754K/sqdn/yr	See table D.2 $110.67/FH x 290FH = $32.1K/acft/yr $32.1K x 24PAA = $770K/sqdn/yr
Replacement Spt Equip (AFP 173-13, Table 14)	
cost/PAA x PAA = sqdn cost $8356 x 24 = $200.5K/sqdn/yr	Baseline x (FX flyaway costs ÷ F-4E flyaway costs) x PAA $8356 x (10.6 ÷ 6.71) x 24 = $316.8K/sqdn/yr
Modification Kits (AFP 173-13, Table 39)	
.000486 x Flyaway cost = cost/acft cost/acft x PAA = cost/sqdn .000486 x $6,710K = $2.95K/acft/yr $2.95 x 24PAA = $70.8K/sqdn/yr	.000486 x Flyaway cost = cost/acft cost/acft x PAA = cost/sqdn .000486 x 10,600 = $5.15K/acft/yr $5.15K x 24PAA = $123.6K/sqdn/yr

Installation Support Personnel

F-4E	FX
BOS (AFP 173-13, Table 18, 27 & 30)	
off x rate + enl x rate + civ x rate ÷ 3 sqdn (2 x $25,752 + 67 x $11,730 + 15 x $21,273) ÷ 3 $386K/sq/yr	baseline (FX manning ÷ F-4E manning) $386K (488 ÷ 568) $332K/sq/yr

F-4E	FX
Real Property Management (AFP 173-13, Table 18, 27, 30)	
enl x rate + civ x rate ÷ 3 sqdns (8 x \$11,730 + 2 x \$21,273) ÷ 3 \$45K/sq/yr	baseline (FX manning ÷ F-4E manning) \$39K/sq/yr
Medical (AFP 173-13, Table 27, 30)	
off x rate + enl x rate + civ x rate ÷ 3 sqdn (1 x \$25,752 + 5 x \$11,730 + 1 x \$21,273) ÷ 3 \$34K/sq/yr	Baseline (FX manning ÷ F-4E manning) \$35K (488 ÷ 568) \$30K/sq/yr

Indirect Personnel Support

PCS (AFP 173-13, Table 29)	
off x rate = off cost enl x rate = enl cost off cost + enl cost = total cost 62 x \$1,051 = \$65.2K 506 x \$335 = \$169.5K \$65.2 + \$169.5 = \$235K/sq/yr	off x rate = off costs enl x rate = enl costs off costs + enl costs = total costs 62 x \$1,051 = \$65.2K 426 x \$335 = \$142.7K \$65.2K + \$142.7K = \$208K/sq/yr

Depot Non-Maintenance

General Depot Spt (AFP 173-13, Table 4)	
Fixed & Variable costs - Variable cost = Fixed costs x 290FH = cost/acft x 24PAA = cost/sqdn \$511/FH - \$435/FH = \$76/FH \$76 x 290FH = \$22K/acft/yr \$22K x 24PAA = \$529K/sqdn/yr	Baseline (FX depot costs ÷ F-4E depot costs) \$529K (4083 ÷ 5407) \$399K/sqdn/yr

F-4E	FX

Personnel Acquisition & Training

Acquisition (AFP 173-13, Table 20)

F-4E

Crew (AFA Grad) x Turnover x Cost
Other off (ROTC) x Turnover x Cost
Enlisted x Turnover x Cost

30	x	.148	x	\$106,500
32	x	.148	x	\$ 20,792
506	x	.135	x	\$ 3,503

\$472.9K + \$98.5K + 239.3K
\$811K/sq/yr

FX

Crew (AFA Grad) x Turnover x Cost
Other off (ROTC) x Turnover x Cost
Enlisted x Turnover x Cost

30	x	.148	x	\$106,500
32	x	.148	x	\$ 20,792
426	x	.135	x	\$ 3,503

\$472.9K + \$98.5K + \$201.5K
\$773K/sq/yr

Individual Training (AFP 173-13, Table 41)

F-4E

Crew x Turnover x UPT
Non-crew off x Turnover x \$5496
Non-crew enl x Turnover x \$7180

30	x	.148	x	\$166,242
32	x	.148	x	5,496
506	x	.135	x	7,180

\$738.1K + \$26.0K + \$490.5K
\$1,255K/sq/yr

FX

Crew x Turnover x UPT
Non-crew off x Turnover x \$5496
Non-crew enl x Turnover x \$7180

30	x	.148	x	\$166,242
32	x	.148	x	\$ 5,496
426	x	.135	x	\$ 7,180

\$738.1K \$26.0K + \$412.9K
\$1,177K/sq/yr

APPENDIX E. O&S COST ESTIMATING MODEL

E.1 General.

For this analysis the Air Force . . . model was used . . . . This model is deterministic mathematical model which is preprogrammed and completely structured . . . .

E.2 Use & Application.

This model has been in use since . . . calculates annual squadron operating costs . . . .

E.3 Model Logic.

Table E-1 lists the algorithms used in the model logic . . . .

E.4 Results.

Tables E.2.A through E.2.( ) are the computer products identifying both input values and results for each alternative . . . .

GUIDANCE: THE FORMAT USED AND THE INFORMATION PROVIDED IN APPENDIX E DEPEND ON THE COMPUTER MODEL USED. IF APPENDIX E IS USED APPENDIX D WILL BE OMMITTED.

TABLE E.1. O&S COST ESTIMATING MODEL ALGORITHMS

UNIT MISSION PERSONNEL

Aircrew
A = Aircrew (Officer) x Officer Pay
B = Aircrew (Enlisted) x Enlisted Pay

Maintenance
C = Maint (Officers) (less air crew) x Officer Pay
D = Maint (Enlisted) x Enlisted Pay

Other Personnel
E = Other Officers x Officer Pay
F = Enlisted x Enlisted Pay

UNIT LEVEL CONSUMPTION

POL
G = Consumption Rate x POL unit costs x flying
Hours per air craft x PAA acft/sqdn x K factor

Maintenance Material
H = O Level cost x . . . .
I = I Level cost x . . . .

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PERSONNEL ACQUISITION & TRAINING

Acquisition
FF = Recruiting Cost factor x Sqdn Personnel x
Turnover Rate x K factor

Individual Training
GG = Specialty Training Cost x Sqdn Personnel x Annual Rate
x K factor

GUIDANCE: WHEN FACTORS ARE USED, INSURE THAT THE EQUATION FROM WHICH THE FACTOR IS DERIVED IS INCLUDED.

TABLE E.2.A ANNUAL SQUADRON OPERATION AND SUPPORT COST ANALYSIS

MODEL:
TIME: 1719.0 Fri 02/08/80

COMPUTER PROGRAM:
DATA FILE:

GENERAL

PAA/SQ.............24
CREWS/PAA..........1.25

FH/PAA/YR - PEACE .. 24
WAR..... N/A

INPUT VALUES	OFFICER	ENLISTED	CIVILIAN	TOTAL
No of Aircrew	30	0	0	30
No of Maintenance Pers	7	370	0	377
Other Pers	35	56	0	91

POL costs - $1.50/gal

o o o o o o o o o o o o o o o o o o o o o o o o o o o o o o o o o o o o o o o o

Acquisition K factor - ...
Individual Training K factor - ...

TABLE E.2.A. (CONTINUED) ANNUAL SQUADRON OPERATION AND SUPPORT ANALYSIS
TIME: 1719.0 Fri 02/08.80 DATA FILE:

RUN RESULTS:

Unit Mission Personnel		6923
Aircrew	845	
Maintenance	4520	
Other	1558	
Unit Level Consumption		10,691
POL	7339	
Maintenance Material	2190	
Training Ordinance	1162	
Depot Level Maintenance		4083
Airframe Rework	1126	
Engine Rework	723	
Component Repair	2099	
Software	135	
Other Depot	-	
Contract Unit Lvl Spt	-	
Sustaining Investment		1211
Replenishment Spares	770	
Replacement Spt Equip	317	
Modification Kits	124	
Other Recurring	-	
Installation Spt Pers		401
Base Operating Spt	332	
Real Prop Mgmt	39	
Medical	30	
Indirect Pers Spt		208
Misc. Operations & Maint	-	
Medical O&M (Non-Pay)	-	
PCS	208	
Depot Non-Maint		399
General Depot Spt	399	
Pers Acquisition & Tng		1950
Acquisition	773	
Individual Training	1177	
TOTAL		25,866

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